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Speech rehabilitation in chronic post-stroke aphasia using visual illustration of speech articulators. A case report study

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► To cite this version:

Célise Haldin, Hélène Loevenbruck, Thomas Hueber, Valérie Marcon, Céline Piscicelli, et al.. Speech rehabilitation in chronic post-stroke aphasia using visual illustration of speech articulators. A case report study. WFN 2020 - 11th World Congress for NeuroRehabilitation, Oct 2020, Lyon (online), France. . hal-03098915

HAL Id: hal-03098915

<https://hal.science/hal-03098915v1>

Submitted on 5 Jan 2021

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CONTEXT

Post-stroke **non-fluent aphasia** (Broca's aphasia) is an acquired communication disorder due to a lesion within the left inferior frontal gyrus and characterized by non-fluent spontaneous speech, agrammatism, anomia, effortful speech production, and without language comprehension disorders [1]. For these patients, speech and language therapy (SLT) should be applied. Studies on rehabilitation of speech disorders suggest that providing visual information on speech articulators may contribute to improve speech production abilities [2,3].

Aims of the study

We evaluate the effect of a visual illustration therapy on speech recovery (investigating the quality of speech production) in a patient with non-fluent chronic aphasia.

METHODS

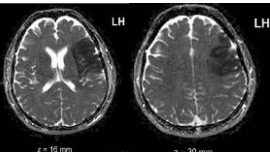


Figure 1 Anatomical MR axial slices illustrating the patient's lesion.

The patient is a 41-year-old male with chronic non-fluent aphasia post-stroke associated with right hemiparesis, due to left-hemispheric lesion with damage to the inferior frontal gyrus, insula, primary motor and premotor cortices and partially the superior temporal gyrus.

Rehabilitation method – Ultraspeech-player software

The patient performed 11 sessions (3 sessions/week, 30min/session), in addition to conventional SLT.



Figure 2 The Ultraspeech-player software [4].

Speech assessment

Before and after rehabilitation, the patient performed: a **phoneme repetition** task (PR); a **word repetition** task (WR) and a **reading** task. For PR, phonemes are French isolated vowels /a, œ, ø, e, ε, o, ɔ, y, u, i, ĩ, õ, ʃ/, semi-consonants in vowel context (/ja, wa, qi/) and consonants in /a/ context (/Ca/ and /aCa/ conditions, C = /p, t, k, b, d, g, f, s, ʃ, v, z, z, m, n, ɲ, l, ʁ/). PR and reading tasks were performed 3 times.

Data processing

We evaluated : (i) overall speech performance (% of correct responses) during each task; (ii) **evolution index** to measure improvement between before and after rehabilitation; (iii) **confusion matrices**; (iv) phonological processes in the errors observed during the PR task. We performed logistic regressions for each task to test whether the evolution of the patient's performance was significant.

RESULTS

Table 1 Accuracy of each task performed during the speech assessment.

	Before rehabilitation		After rehabilitation		EI	z value	p-value (*p <.01 and **p <.001)
	rehabilitation	rehabilitation	rehabilitation	rehabilitation			
PR	/Ca/	57.30%	80.30%	80.30%	+8	2.95	0.00316*
	/aCa/	32.65%	65.67%	65.67%	+12	4.09	4.31*10 ⁻⁵ **
	/V/	34.48%	39.68%	39.68%	+1	0.59	0.55462
WR		43.04%	56.27%	56.27%	+13	3.06	0.00218*
Reading		39.22%	66.67%	66.67%	+11	2.74	0.00614*

Table 2 Percentage of typical phonological processes in the errors observed during the phoneme (consonant) repetition task .

	Before rehabilitation	After rehabilitation
Devoicing	24.8%	13.5%
Voicing	1.9%	2.3%
Velar fronting	50.0%	11.1%
Fricative stopping	1.6%	2.0%
Coronal backing	4.0%	4.1%
Lateralization	1.5%	0.3%
Nasalization	58.0%	18.2%

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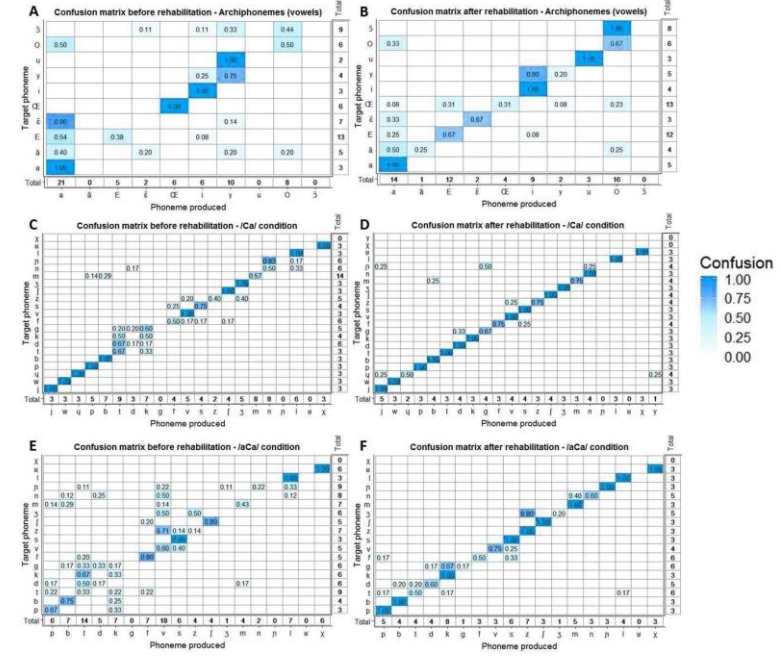


Figure 3 Confusion matrices showing target phonemes as a function of produced phonemes, as well as the number of target phonemes requested (in row) and the number of actually produced phonemes (in column). The confusion matrices show: (A–B) isolated vowels with archiphonemes (/OE/ = /œ, ø/, /O/ = /ɔ, o/, /E/ = /e, ε/; (C–D) consonants and semi-consonants in /Ca/ condition; (E–F) consonants in /aCa/ condition. The confusion degree (CD) is a value between 0 (the correct phoneme was never produced like the corresponding target) and 1 (no confusion; the actually produced phoneme is the target phoneme; phoneme production was 100% correct).

Conclusion

The illustration-based rehabilitation method had a **positive effect** on the patient's speech production, with an increase of correct responses associated with better coordination and control of speech articulators and less confusion between stop and fricative consonants. Moreover, the greater improvement on consonants which were specifically trained using the Ultraspeech-player, supports the argument that **visual articulatory illustration is an effective approach for speech recovery.**